Studying the rock-loving *Pinguicula lithophytica* of Cuba

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Introduction

This article is intended to provide additional information that is associated with the new species, *Pinguicula lithophytica* C. Panfet-Valdés & P. Temple but not included in the initial description (see page 90).

Pinguicula lithophytica was encountered during several visits to the Macizo Mountains of the Escambray in the Central Region of Cuba. During the first visit we found that the plants grew on vertical or near vertical calcareous rock walls, generally at the top, with numbers decreasing toward the ground. Few plants were found at lower levels of the rock face. However, further visits revealed that subsequent generations of the plant population moved, generally downward or sideways by up to 5 m. Further study revealed that the colonies were not growing where nearby trees, mainly coffee, had grown to create dense shade or where plants sharing the rock face grew bigger and out-competed the *Pinguicula* for light. Thus, it appears that *P. lithophytica* is a pioneer plant, colonising open areas of near vertical calcareous rock but unable to compete with other plant species that move in and take over.

The rock face where we first found *P. lithophytica* is part of a rock outcrop that is flat or almost flat on top, and there covered in very dense forest. The forest continuously sheds leaves that cover and therefore hides the substrate in which it grows. Carefully moving the decomposing leaf litter away revealed that the forest floor is composed of weathered and worn limestone, which from its sharp and irregular form can be seen to be at least in part the remains of coral. This calcareous rock easily allows rainfall to filter down through it and much of the water that does so then moves horizontally to seep out of the rock at the vertical or sloping sides. This seepage, either alone or possibly in association with rain that directly impacts the rock face, continuously wears away the wet and therefore soft rock wall. (When dried, samples of the rock set like concrete into a solid hard mass.) *Pinguicula lithophytica* grows on these wet deteriorating rock faces. By their nature, the rock faces are constantly wearing down so they cannot provide a permanent home. New plants constantly repopulate the ever-changing rock face.

Habitat threats and conservation

Even a single visit was enough to show that the area is heavily affected by people, and especially agricultural work; coffee plantings surround the area. Repeated visits revealed the extent of this impact, as coffee was clearly encroaching on the habitat both by being planted nearer to it and because the coffee was allowed to grow tall such that the habitat became increasingly more shaded and less suitable for *P. lithophytica*.

However, in general this area is not subject to massive disruption as a result of human interference such as farming or mining. This is in sharp contrast to other areas, including the Western lowlands of Pinar del Rio where farming and fires (accidental or otherwise) cause much carnivorous plant habitat damage and the Eastern highlands of Moa where mining causes significant impact.

Notwithstanding any actual or potential threats, *P. lithophytica* is found within a National Park where conservation is a primary and well practiced aim. (In fact all Cuban flora is protected under local conservation laws.)

Flower colour compared to *P. albida* and *P. jackii*

When the type specimen was encountered, the flower colour was recorded as white and photos taken at the time seem to support this. However, the first description of *Pinguicula jackii* Barnhart included mention of another species which Barnhart described as "probably merely the long-known *P. albida* of Wright, but with the white corollas sometimes showing a narrow margin of color". Seeds of *P. lithophytica* have been grown and the resultant mature plants were examined while flowering. The flowers of these cultivated plants clearly demonstrated the colouration that Barnhart described, petals being white in general but with a very fine touch of violet-blue colour along the edge of the petal lobes. Closer inspection revealed that each lobe is very lightly marked with fine violet-blue veins. As the original plants referred to by Barnhart do not appear to have associated herbarium sheets and as no further reference to the plants has been found, no other features are available to be compared. However, it seems improbable that this colouration of *P. lithophytica* can so match Barnhart's unidentified species and not be one and the same, especially as no other *Pinguicula* species appears to have colouration that is similar. The species Barnhart described as "probably merely the long-known *P. albida* of Wright" cannot be expected to have been *P. albida* as that species is of the lowlands, requiring constantly high (day and night) temperatures that are not encountered above 100 m. above sea level. Further, the flowers of *P. albida* have never been described as other than white, photographs of wild and cultivated plants show nothing other than white flowers and our own cultivation of *P. albida* never revealed any plants with violet-blue (or any type of blue) tipped petals.

The violet-blue veins of *P. lithophytica* may be so fine and faint as to be almost invisible without the aid of a camera, lens or microscope. As to the petal edges, these too are so finely tipped with violet-blue that one can almost believe the colour to be imagined, though a sideways glance or a maintained stare will reward the observer with a view of this truly unique *Pinguicula* colouration. As yet, we still do not know if wild plants are white because of exposure to more sunlight, for other causes deriving from the habitat or for other reasons, including that the colouration may be less noticed than if observing in a laboratory or other controlled situation. It is also worth noting that, by comparison, *Pinguicula jackii* has petals that are blue, not violet-blue, and the blue occurs on the entire petal surface, and not just at the lobe tips.

Ecological conditions

Pinguicula lithophytica is found at 725 metres above sea level. Although Cuba is within the tropics, at this elevation the nights are cool or even cold while the days are generally hot. In addi-

tion, the altitude results in nightly clouds that shroud the mountain. This contributes to the high humidity levels maintained by the water seeping from the rock. As is normal for *Pinguicula*, the plants are found in a north-westerly aspect, where direct sunlight is avoided. *Pinguicula lithophytica* habitat is exposed to a hot dry season and a cooler wet season. Excluding periods when hurricanes are affecting Cuba, the mountains can be significantly more breezy than the tropical lowlands. The variations in humidity and temperature encountered in the region where *P. lithophytica* is found are shown in Figure 1.

Although *P. lithophytica* lives within the same general area as *P. jackii*, we have never encountered the two species on the same rock face, though this is not evidence that they could not share the same habitat. Plants that did occur with *P. lithophytica* included *Chaptalia dentata* and *Begonia banaoensis*, bryophytes, and some fern species. On the top of the calcareous rock outcrops, we found mixed forest with epiphytes including orchids, ferns and *Peperomia* species. This forest floor was littered with old leaves and with some plants including terrestrial orchids.

Cultivation

Since its rediscovery, *P. lithophytica* has been cultivated and the entire life cycle observed through multiple generations. Meanwhile, *Pinguicula jackii* was first introduced into general cultivation by Harald Weiner in the 1980s. Regrettably, there is no record of anyone having succeeded in maintaining plants sourced from Weiner, presumably through ignorance of the plant's requirements. Fortunately, *P. jackii* is now back in cultivation and so comparison of the requirements of the two species can be made.

There are no significant differences between the basic requirements of *P. lithophytica* and *P. jackii*. Both have been grown to flower using a medium of calcareous rock. In the case of *P. lithophytica*, crushed tufa was used while for *P. jackii*, more readily available calcareous rock taken

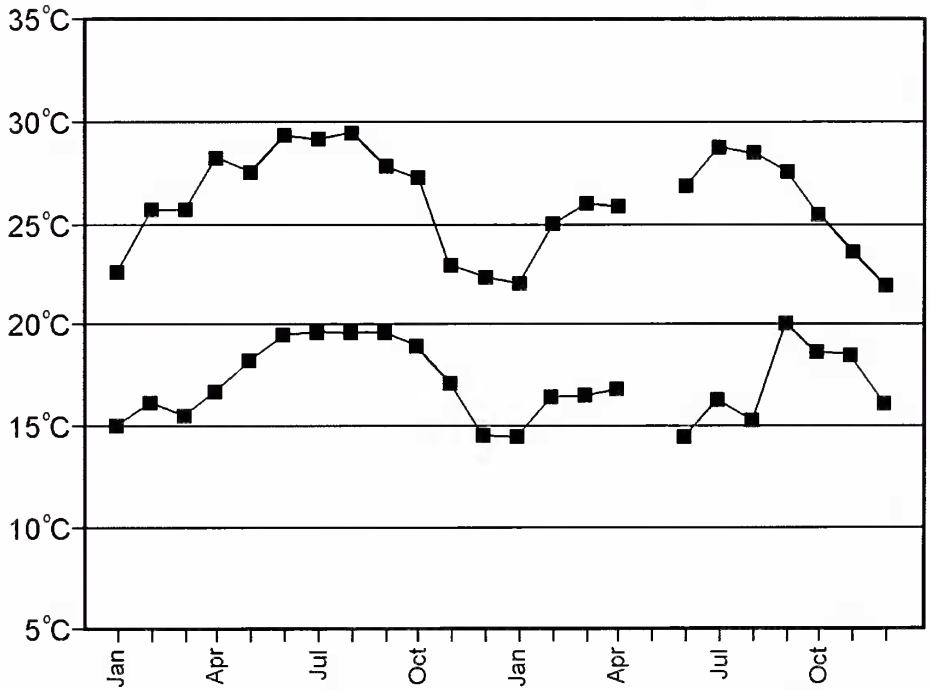

Figure 1: Temperature daytime maxima and nighttime minima as measured during a two-year period. No data were recorded for May of the second year.

from the habitat was used. Both plants required high humidity levels. Not much more is known about the water requirements of *P. jackii* as the plant has been maintained in fairly constant humidity in the calcareous growing medium that has been kept wet at all times. However, *P. lithophytica* has undergone additional experimentation and, provided the surrounding air is kept very humid, no water need be added to the calcareous growing medium for at least 6 months! Considering the nature of the constantly seeping habitat, such drought tolerance is a surprise. Should plants become generally available for cultivation, caution is advised with regard to attempts to replicate such dry conditions as a suitable growing method.

Both plants have been grown in strong light but protected from direct sunlight which will burn the leaves and ultimately kill such exposed plants. No experiments have been made with any form of plant food or fertiliser but it would be unusual for a *Pinguicula* to require, appreciate or even tolerate such treatment, especially in high or frequent doses.

Pinguicula lithophytica took 13 months to develop from fresh seed into flowering plants. Once flowering began, the same plants continued in flower for 6 or more months. Once flowering ceased, no plants that had flowered ever produced more flowers, even up to 3 years later. Seeds were first obtained by manually pollinating a single flower with pollen taken from that same flower. The resultant seed capsule was filled with copious seed all or nearly all of which were viable. *Pinguicula lithophytica* has been grown *in vitro*, though details of the medium or media used are not known.

Studying plants in Cuba

It goes without saying that Cuba is a plant-lover's dream. The country is packed with endemic species; it is just about impossible to visit the countryside without passing or even stepping on one or more botanical treasures. For *Pinguicula*-lovers, Cuba is a paradise, with numerous species, most of which are rare and all of which are endemic and attractive as well as interesting (to say the least). However, going to Cuba to see plants is not as easy as one might think, unless of course the intention is to see plants in Botanic Gardens. The Botanic Gardens are well designed and well stocked with a fantastic range of non-carnivorous plants. Efforts have been and are being made to grow carnivorous plants in the National Botanic Gardens in Havana but their availability is unreliable as Havana has a lowland climate that is a challenge to growers of the endemic *Pinguicula* species, many of which grow naturally in the highlands. (However, do not let that put you off a visit as the other plants are a delight, as are the Botanic Gardens' restaurants!)

If the intention is to see plants in the wild, this needs knowledge, assistance, planning and permission. To begin with, Cuba takes conservation very seriously. All countries are limited by their available budget and Cuba is no different. Cuban laws have strengthened their conservation efforts. It is now illegal for anyone to visit Cuba with the intention of entering the countryside to look for flora or fauna unless that person complies with the country's requirements. This means that a tourist visa simply will not do, a scientific visa is required even if you just intend to look, let alone study or take photographs. In order to obtain a scientific visa, the trip must be arranged by local people in Cuba and these people will need to be approved to make such arrangements. This is not optional. If they are not approved before you approach them, it is unlikely they will be given approval just because you want to visit. You will have to agree to take no plant or animal material out of Cuba, not even seeds. You will also be expected to agree that any knowledge gained as a result of your expedition will be published by your Cuban hosts, although it is possible to participate in joint publication as a co-author. You will also be wise to expect or offer to assist with the full costs of publication as such costs can be prohibitive for Cuban botanists and the organisations that employ them.

All National Park land in Cuba is supervised. This is done both by the local forest guards and by park supervisors, the latter sometimes being botanically aware or even expert. They do take an interest in all visitors, whether on foot, in vehicles, or on any other mode of transport! All

supervisors are free to approach any visitors to check the reason for their presence, to check if appropriate permission has been obtained (proof can be requested and required), and even to ensure that no specimens are being removed; searches are possible. The punishment for breaking the rules can be severe and immediate! One member of a party caught breaking a rule can cause the whole party to be held responsible.

However, field trips are welcomed. To undertake a field trip, letters will need to be sent to the relevant scientific institutions, for botanical trips these would normally need to be sent to the Ecology and Systematic Institute. The Cuban hosts, will thereafter assist with whatever guidance is needed. You will need to initiate contact at least six months in advance of the date of your intended trip, although this is really cutting it very fine, especially if you have had no previous contact with Cuban institutes; two years is a good realistic time to allow for planning unless you know exactly what you are doing and have prior experience in Cuba. Obviously, working with someone who knows what to do will help, but the Cuban authorities are used to organising visits for people new to Cuba and are both friendly and helpful.

Oh yes, one last thing. You will need funds. Getting around in the Cuban countryside, especially to see carnivorous plants, will require trips into areas where most available maps are useless. Weather or industry can destroy roads, and tracks may be muddy or impassable. They can even disappear seasonally! You will need a suitably robust vehicle and a good driver for you and your Cuban colleagues. As field trips are costly for Cuban organisations, it is not uncommon to find oneself accompanied by as many other local botanists as can fit in the transport. You will need to pay for everything, including all of the people, their wages (assessed to be what Cuba expects a European or American botanist to be paid), car rental, fuel, and all food and accommodation. Your coordinator (one will be assigned to you) will be able to tell you the probable cost in advance.

Permits

All of the various visits made to see and study Cuban *Pinguicula* have been done with appropriate permission from the relevant authorities. The expeditions did not require scientific visas as these have only become a requirement very recently. However, general permission to allow the first author to visit Cuba for the purpose of studying Cuban *Pinguicula* (and other carnivorous plants) was first obtained from the Cuban Consulate in London (United Kingdom). The Botanic Gardens in Havana then arranged all other permits needed to allow the expeditions to go ahead. In addition, staff from the Botanic Gardens (Jardin Botanico de Havana) accompanied all expeditions and, in some locations, local National Park supervisors participated in the field trip. No material was photographed or removed without permission. All Cuban laws and regulations were respected at all times.

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Looking Back: CPN 25 years ago

Bruce Lee Bednar wrote: "A new monograph is needed for the genus *Nepenthes*. The *mirabilis* complex needs much work itself. Until a standard is achieved, many *Nepenthes* collectors will remain lost." Twenty-five years later we have seen many advances in our understanding of the genus, perhaps most visibly by Clarke's fine books. But in many ways, we are no closer to understanding *Nepenthes mirabilis*. I would love to see a more comprehensive review of these plants, and perhaps especially those of the Philippines and Thailand. (BR)